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DIRECTORATE OF
INTELLIGENCE

# *Imagery Analysis Report*

## Failure of San-men Gorge Reservoir Project, China

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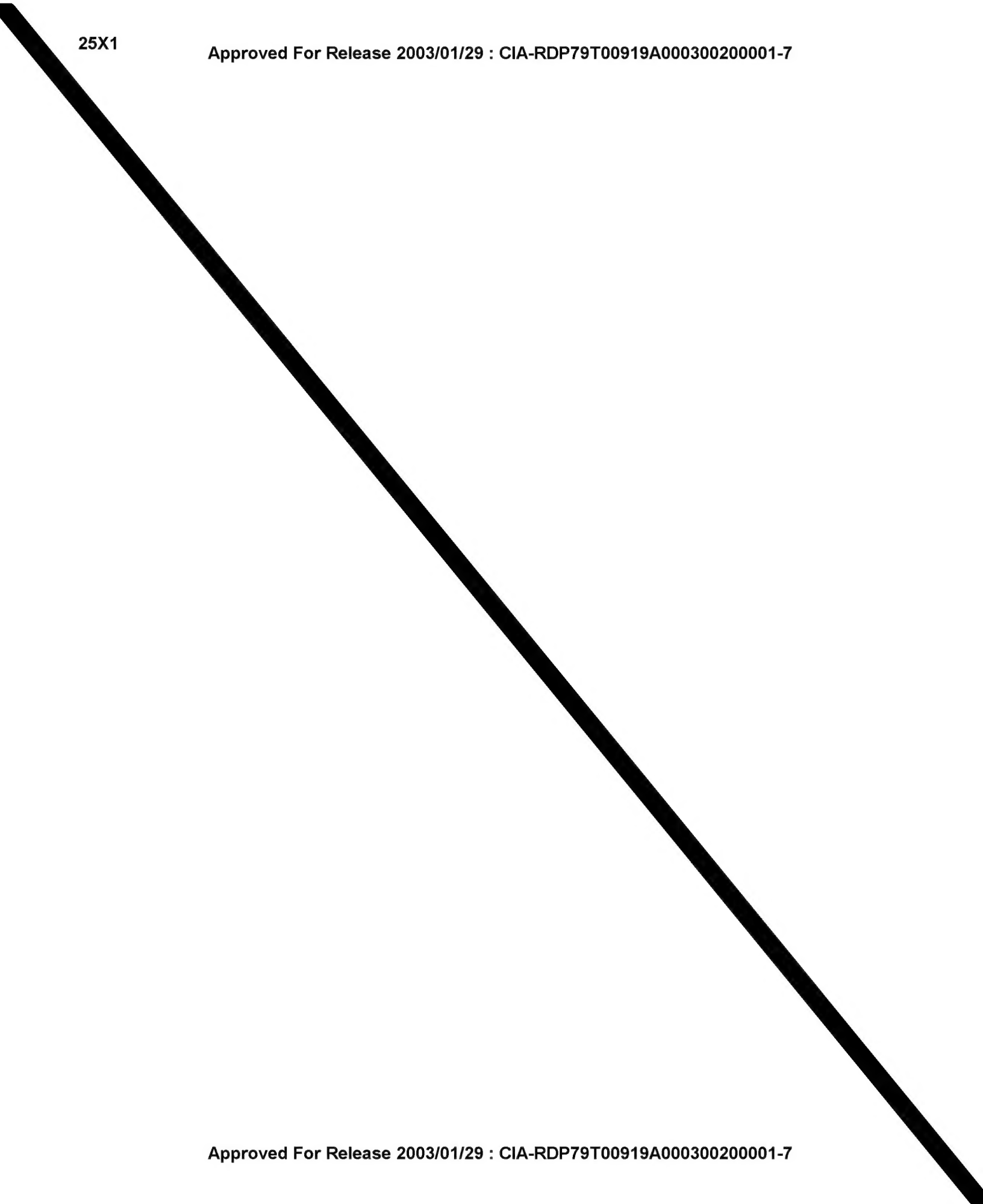

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[redacted] 25X1

December 1967

# FAILURE OF SAN-MEN GORGE RESERVOIR PROJECT, CHINA

## SUMMARY

An analysis of photography [redacted] reveals that 25X1
the Chinese were forced to drain the San-men Gorge Reservoir [redacted] 25X1
25X1 [redacted] because of sedimentation problems. The problems encountered were excessive sedimentation deposits forming within the reservoir and scouring of the river bed downstream. Failure of this project has deprived the Chinese of a regulator for flood control, a reservcir capacity for irrigation and a dependable water supply for the associated hydroelectric power plant. The plant was in the late stages of construction [redacted] 25X1
but is probably still not in operation. Moreover, the Chinese have been unable to provide a dependable supply of water downstream for navigation channels.

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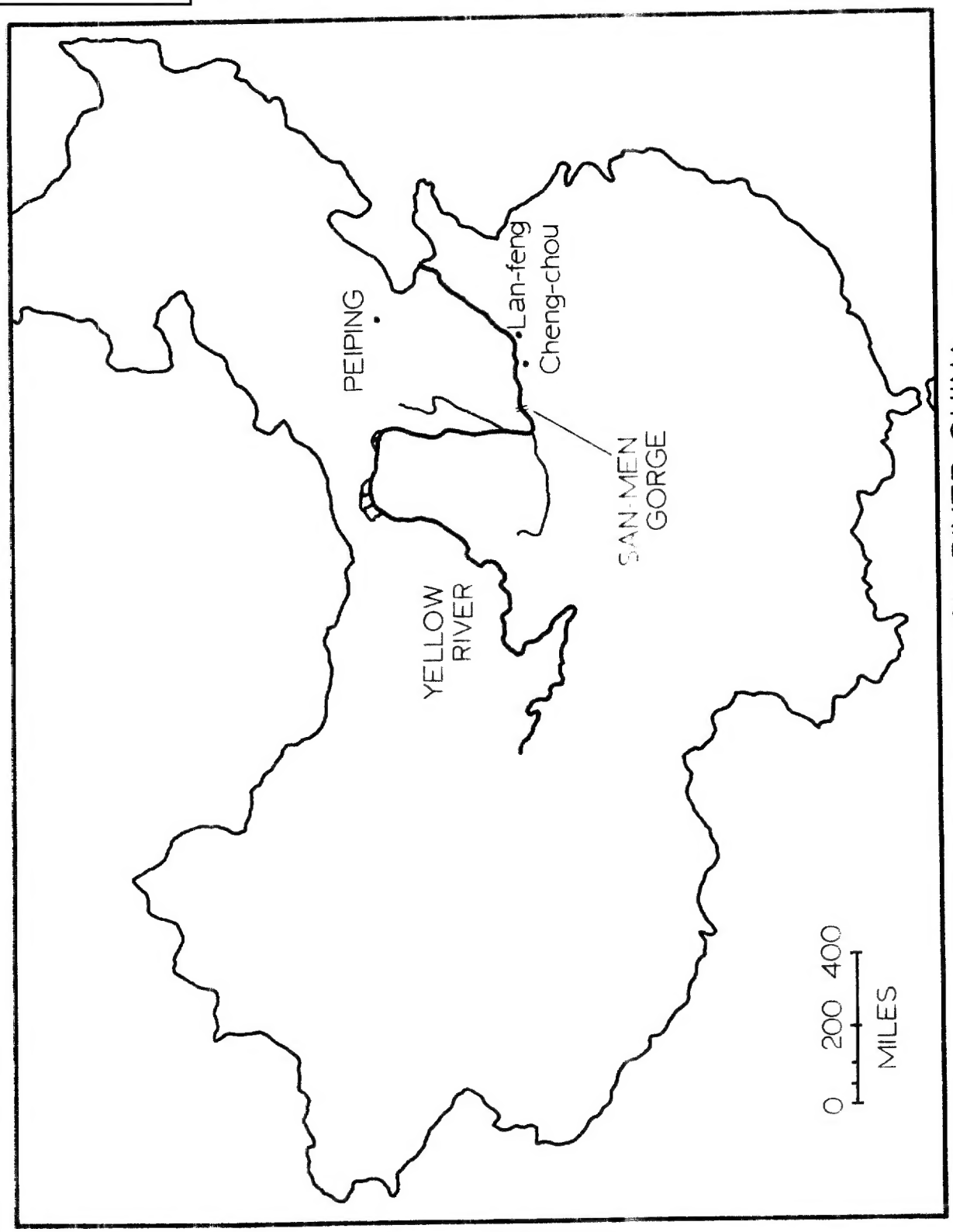


FIGURE 1 YELLOW RIVER, CHINA

## INTRODUCTION

The San-men Gorge Reservoir is located on the middle course of the Yellow River at San-men-hsia (34-49-40N 111-20-40E). Construction of this multi-purpose project began [redacted] and the dam was closed by [redacted] This dam was to be a key project of a Chinese plan for permanently controlling the unruly Yellow River. The Chinese plan, first made public [redacted] included a series of multi-purpose and silt retention dams on the middle course of the main river and many smaller silt retention dams on the tributaries. It was thought that with these silt retention dams and the help of additional soil conservation practices in the drainage area, the usefulness of the multi-purpose reservoir at San-men could be greatly extended.

The purpose of this report (based on good to fair quality photography [redacted] is to determine the effectiveness of this reservoir as a multi-purpose water conservation project. Annotated photo enlargements are presented along with the discussion of the drainage area, reservoir, hydroelectric plant, navigation, and the effect of retrogression on the diversion of water into the Cheng-chou Irrigation Canal (34-55N 113-36E) and the Lan-feng Irrigation Canal (34-53N 114-44E).

## RESERVOIR

The San-men Gorge Reservoir is situated in a deep canyon on the middle reaches of the Yellow River (Figure 2a). When filled, the reservoir extends 55 nautical miles (nm) upstream from the dam at San-men Gorge to the confluence of the Yellow and Wei Rivers. The reservoir dam is reported to be 350 feet high and is approximately 3,000 feet long. Its capacity is reported to be over 28 million acre feet.

25X1 Photography [redacted] revealed that the reservoir was partially filled. The tone of the water entering the reservoir indicated that it was carrying a large amount of silt (Figure 2a), and the volume of water in the river downstream from the dam appeared to have been reduced. 25X1 During [redacted] all of the sluice gates were open, the reservoir was empty, and large deposits of silt were visible in the reservoir (Figures 2b and 3). Later photography [redacted] 25X1
25X1 [redacted] revealed that all of the sluice gates continued to be left open, and the reservoir was still empty.

## HYDROELECTRIC POWER PLANT

The external features of the hydroelectric power plant associated with the dam at San-men appeared to be in the late stages of construction on 25X1 photography [redacted] (Figure 4). At this time all of the cofferdams and the construction equipment that had been located on the river floor were removed. The switching facility, substation, and transmission lines were nearing completion and the last of eight turbogenerator sections was being roofed; however, it was not possible to determine the number of turbines or generators that had been installed. Covered transformer cells (two per turbogenerator) were being constructed between the generator hall and dam; six of the cells were under construction. More recent photo coverage of 25X1 [redacted] indicated that the power house was completely roofed, and that only three of the transformer cells had been covered. The switching facility at the western end of the generator hall appeared to be completed with eight sets of switch gear installed. A cantilever crane was still located on the roof of the power house, and a traveling support tower with aerial cable-way was still present. On [redacted] photography three 25X1 turbine housing outlets were discharging water; on [redacted] photography 25X1 four outlets were discharging. The spillway has been in operation on all photographic coverage. Since no head of water has formed [redacted] and 25X1 the discharge from turbine housing outlets observed [redacted] 25X1
25X1 [redacted] were from turbogenerator sections where transformer cells had not been completed, it is probable that the power plant was not in operation.

## DRAINAGE AREA

The drainage area for the reservoir covers over 100,000 square miles consisting of most of the Loess Plateau located in the provinces of Shensi, Kansu, Shansi, and Honan. The principle rivers within this region are the Yellow River and its tributaries.

The Yellow River flows out of the Ordes Desert as a wide, slow river. As the river turns southward from the Great Bend, it enters the Loess Plateau, increases its gradient, and becomes a fast-flowing river in a deep, narrow valley. The main left bank tributary, the Fen, rises in the mountains of eastern Shansi Province and flows southward to its confluence with the Yellow River. The Wei, the main right bank tributary flows from west to east along the foot of the steep northern face of the Tsinling Mountains and carries a heavy load of sediment.

The Loess Plateau is an old dissected peneplain which has been covered by a layer of wind deposited dust varying from a few feet to over 250 feet thick. This light unconsolidated loess is commonly overtilled, and without its natural vegetation cover and under the influence of heavy summer downpours, is extremely susceptible to erosion. Photography reveals (Figure 5) that natural vegetation covers less than five percent of the plateau, and that gully and sheet erosion occur over a large portion of the drainage area. With 65 percent of the total annual rainfall occurring in July, August, and September (Table 1),usually as heavy downpours, tremendous quantities of silt are being washed into the Yellow River.

The immediate task to reduce erosion in a watershed usually is to recreate the natural vegetation by aforestation and grass planting. Recent photography indicates that the Chinese have accomplished very little toward this first step of erosion control nor have they begun construction of silt control dams on the Yellow River and its important tributaries.

## EFFECT OF RETROGRESSION ON THE DIVERSION OF WATER INTO THE CHENG-CHOU AND LAN-FENG IRRIGATION CANALS

The deposition of sediment in a reservoir and the subsequent release of clear water will generally cause a scour or degradation of river bed below the dam. The removal of bed deposits by clear water may lower the river below existing canal intake structures.

25X1 Photography [redacted] indicated the Chinese are having difficulty in obtaining a sufficient supply of water for the Cheng-chou and Lan-feng Irrigation Projects (Figures 6 and 8) located 130 and 210 nautical miles downstream from the dam. During this five year period the canal intake gates were photographed in both the wet and dry seasons, times when the river would normally be at its highest and lowest levels. Dates when the water was above or below the intake gates are given in Table 2. This table includes all available coverage from the date the 25X1 dam was closed [redacted] Since there is insufficient photographic coverage of the canal intake gates before the dam was closed, the extent of retrogression cannot be determined. It is evident, however, that only a small amount of water for irrigation is available during the wet season and that even less water is available during the winter wheat growing season of March, April, and May when evaporation generally exceeds rainfall in these irrigation projects. In addition, during the wet season of 1965, flood waters destroyed the major portion of the Cheng-chou Diversionary Dam located at 34-55N 113-36E (Figures 6 and 7). This further complicates the task of obtaining sufficient water for the Cheng-chou Irrigation project.

## DOWNSTREAM NAVIGATION

The San-men Reservoir project was part of an overall plan for improving the inland waterway transportation system in China. The San-men Reservoir impoundment was to be utilized, along with additional water from the Yangtze and Han Rivers, to increase the capacity of the downstream navigation channels. The Chinese had planned to make the Yellow River navigable for barge traffic as far inland as Cheng-chou. The failure of the reservoir project would appear to be a serious setback to their ambitious program for improvement of the inland waterway net.

TABLE 1. DISTRIBUTION OF ANNUAL RAINFALL

| Reservoir drainage area | Dec-Feb | Mar-May | Jun-Aug | Sept-Nov |
|---|---|---|---|---|
| | 4 Percent | 15 Percent | 56 Percent | 25 Percent |

TABLE 2. WATER LEVEL ABOVE OR BELOW CHENG-CHOU AND LAN-FENG INTAKE GATES

25X1

| | Cheng-chou | Lan-feng |
|---|---|---|
| | below | below |
| | above | above |
| | below | below |
| | below | below |
| | below | below |
| | below | below |
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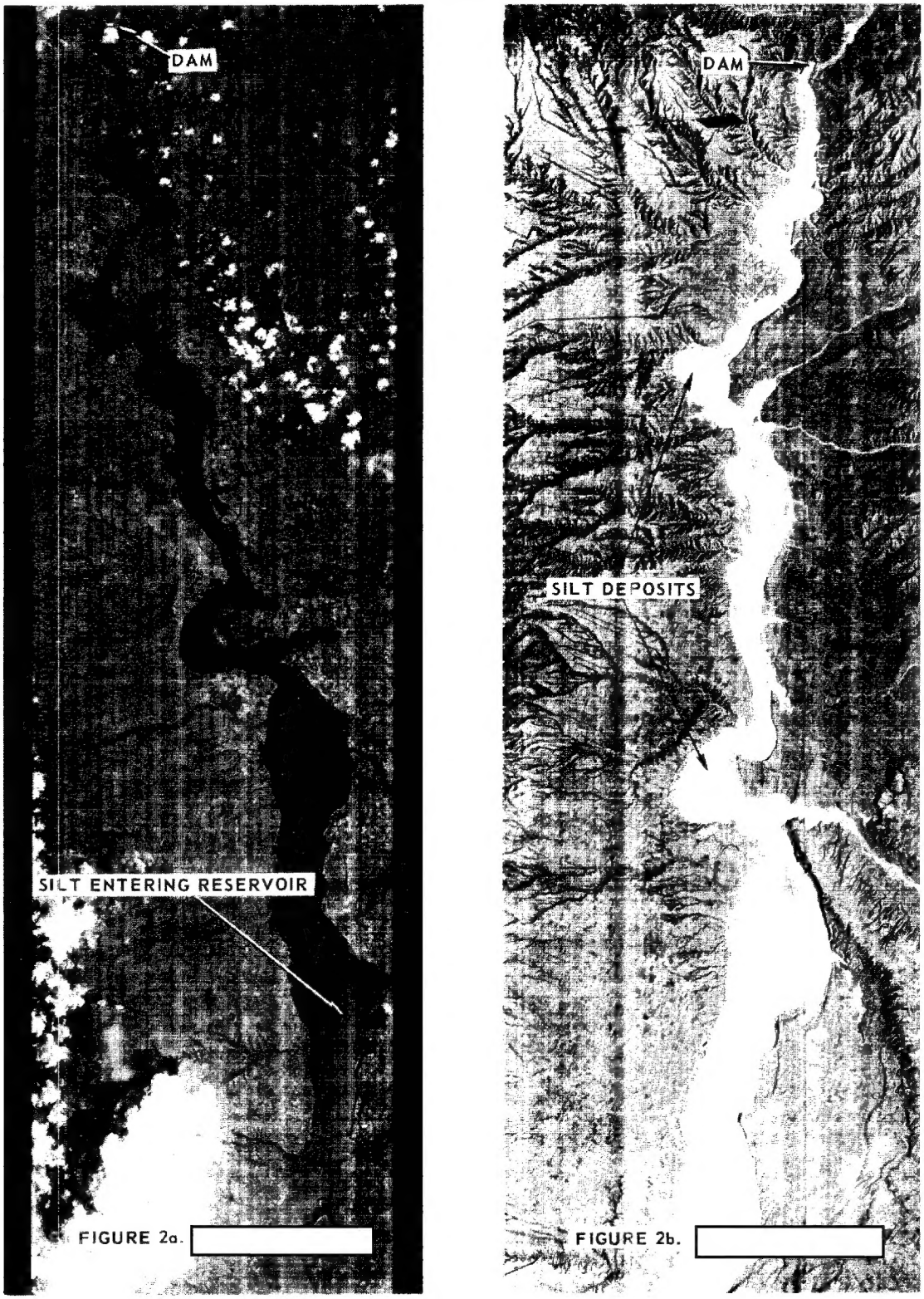


*FIGURE 2. SAN-MEN GORGE RESERVOIR*

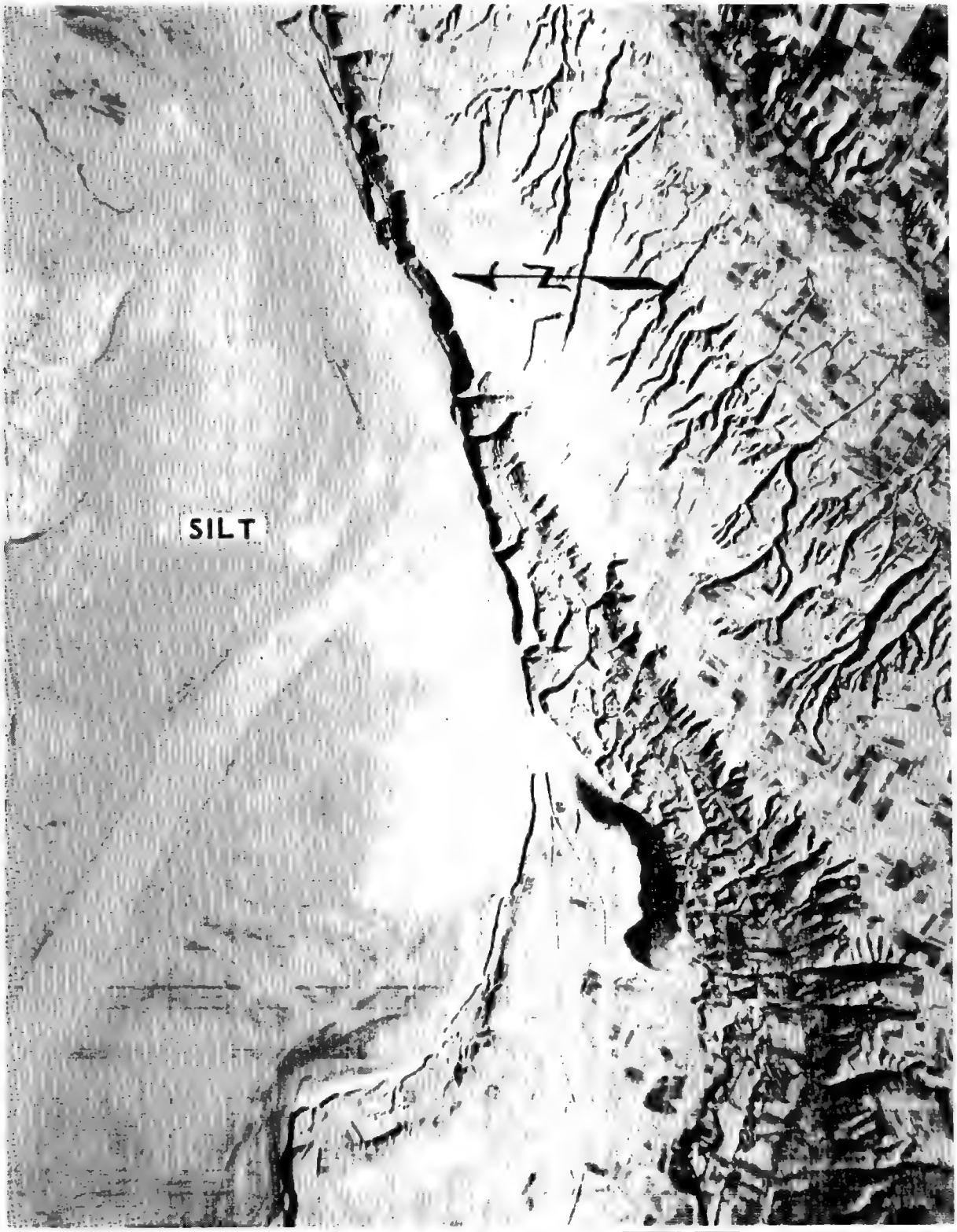


*FIGURE 3. SAN-MEN RESERVOIR SILT DEPOSITS,* 

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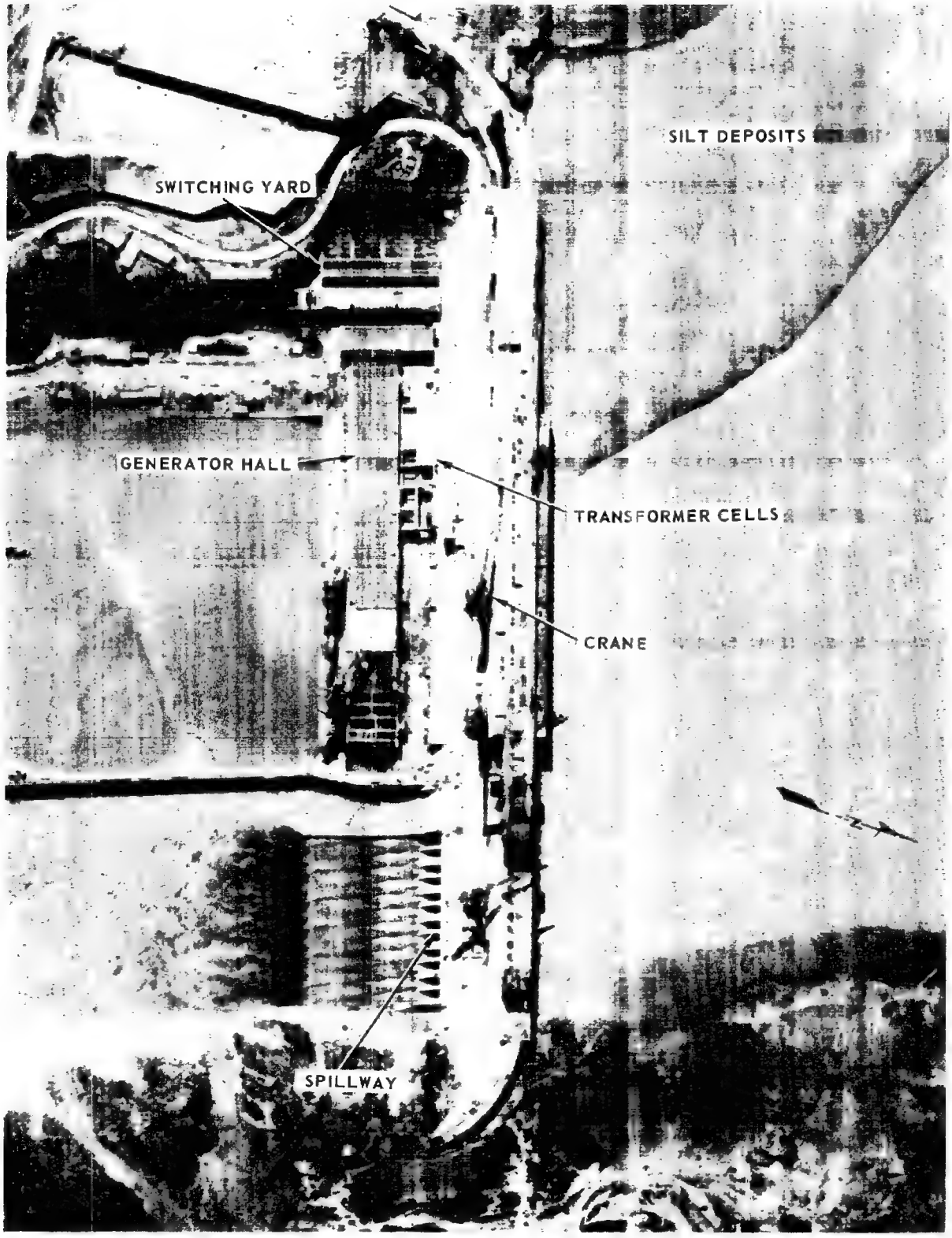


*FIGURE 4. SAN-MEN HYDROELECTRIC DAM.*

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FIGURE 5. ERODED LOESS, 25X1

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FIGURE 6. CHENG-CHOU CANAL INTAKE GATE, 25X1

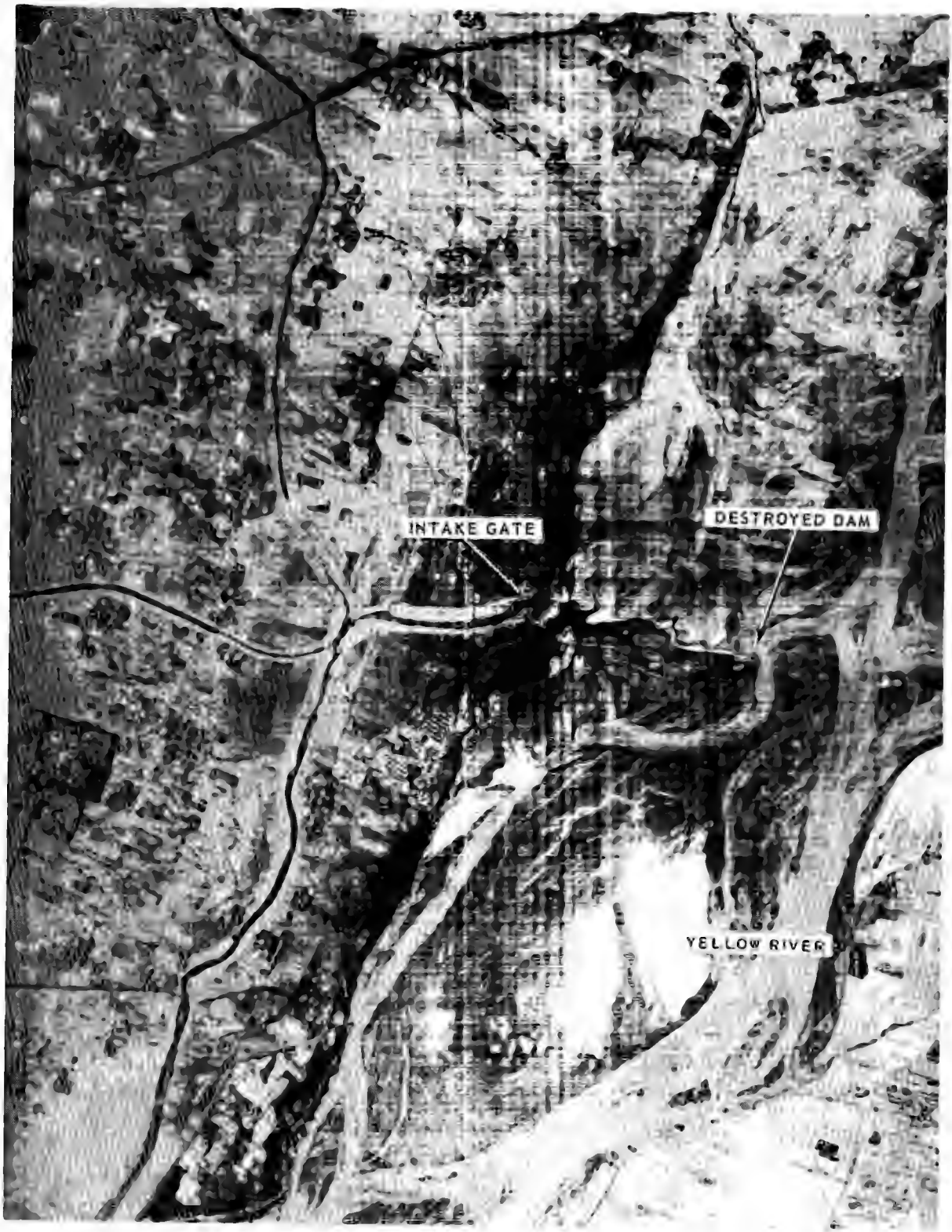


FIGURE 7. CHENG-CHOU CANAL INTAKE GATE.

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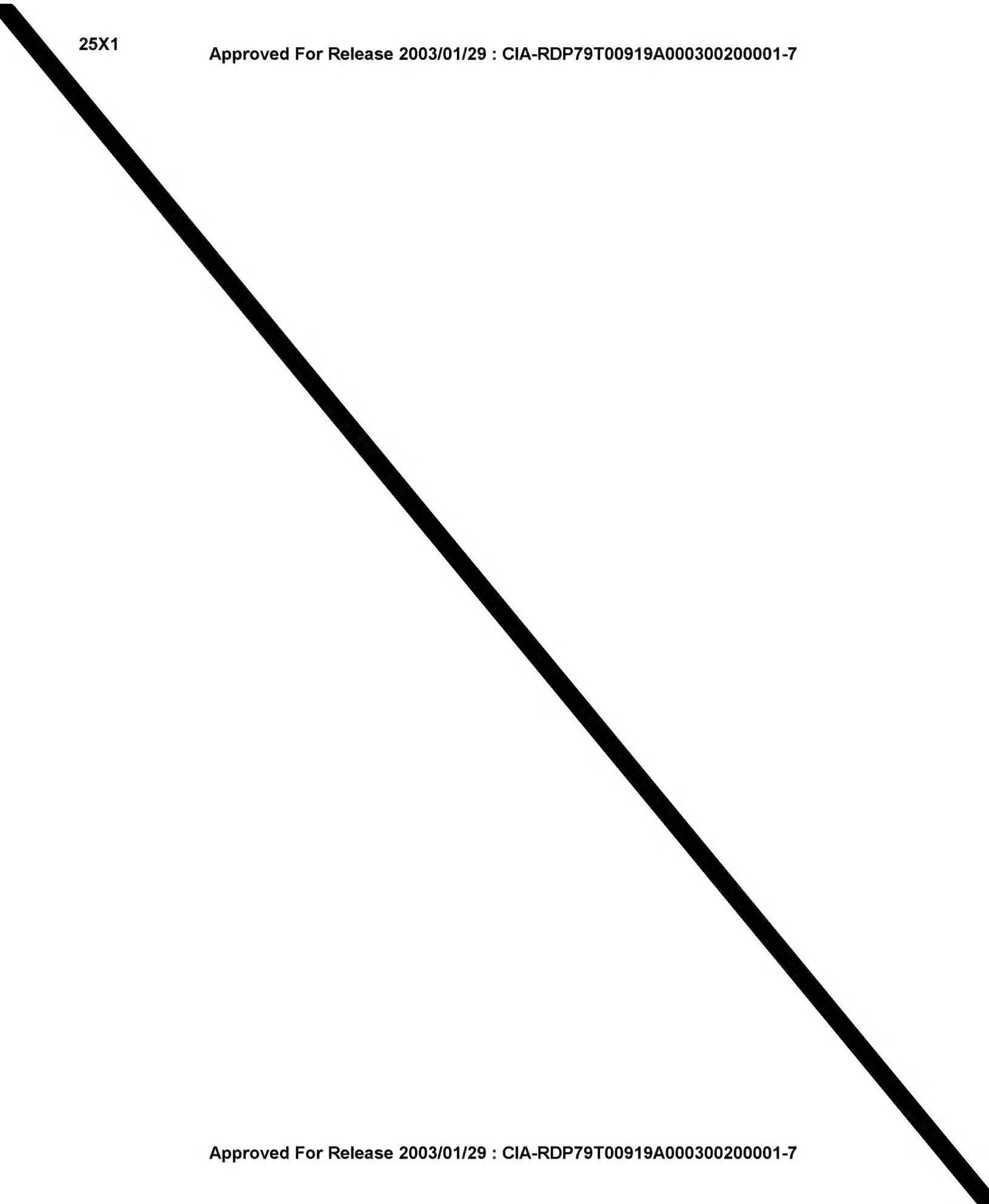
FIGURE 8. LAN-FENG CANAL INTAKE GATE



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Maps and Charts

ACIC. USAF Operational Navigation Chart, Sheet ONC-G-9, scale 1:1,000,000 2nd classified ed., March 1963 (CONFIDENTIAL)

ACIC. US Air Target Chart, Series 200, Sheet 0335-7AL, scale 1:200,000 1st ed., August 1960 (SECRET)

ACIC. US Air Target Chart, Series 200, Sheet 0335-9H1, scale 1:200,000 2nd ed., November 1963 (SECRET)

Documents

1. Trogear, T.R., A Geography of China, Aldine Publishing Company, Chicago, 1965 (UNCLASSIFIED)

2. JPRS. Water Resources of China, November 1965 (UNCLASSIFIED)

3. JPRS. Climate of China, June 1967 (UNCLASSIFIED)

4. JPRS. The Physical Geography of China, September 1965 (UNCLASSIFIED)

5. Stanley, J.W., "Retrogression on the Lower Colorado River after 1935," American Society of Civil Engineers, April 1947 (UNCLASSIFIED)

6. Corfitzen, W.E., "Economic Effects of Reservoir Sedimentation," American Society of Civil Engineers, April 1947 (UNCLASSIFIED)

Requirement

C-RR7-34,520

IAS Project

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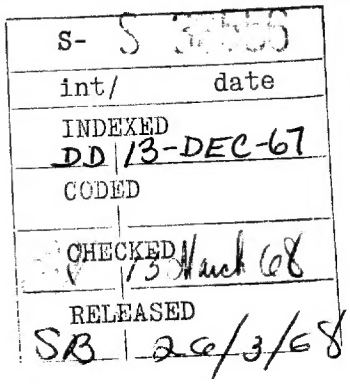
[redacted]

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